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EXAMINER	
LANDAU, MATTHEW C	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 08/22/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/811,752	NEGLEY, GERALD H.	
	Examiner	Art Unit	
	Matthew Landau	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 June 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-44* is/are pending in the application.

4a) Of the above claim(s) *6 and 19-44* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-11 and 13-18* is/are rejected.

7)☒ Claim(s) *12* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 June 2006* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Claims 6 and 19-44 withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant elected without traverse in the reply filed January 6, 2006.

Drawings

The drawings were received on June 15, 2006. These drawings are unacceptable since they introduce new matter (see Specification objection below).

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "plurality of silicon dioxide portions on said p-type Group III nitride layer" (claim 11) must be shown or the feature(s) canceled from the claim(s). Note that Figure 3 shows a plurality of silicon dioxide portions on an n-type layer 16. No p-type layer is present in Figure 3. Also, "said second silicon dioxide layer is limited to said source composition portions" (claim 12) must be shown or the feature(s) canceled from the claim(s). Note that Figure 3 shows the second SiO_2 layer 14 is formed over the entire area, not just the source composition portions. No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure

must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

The amendment filed June 15, 2006 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: Figures 5 and 6 (and the corresponding description thereof) show a plurality of p-type Group III nitride layers 11 on an n-type layer 16. However, the only support for this configuration is in Figure 4, which shows p-regions 31 within layer 16. There is no support for a plurality of p-layers on top of layer 16 as shown in Figures 5 and 6.

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Objections

Claim 18 is objected to because of the following informalities: the limitation "$Ga_xAl_yIn_{1-x-y}$" should be changed to "$Ga_xAl_yIn_{1-x-y}\underline{N}$".

Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 3-5, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy (US Pat. 3,925,121) in view of Ogihara et al. (US Pat. 5,700,714, hereinafter Ogihara).

Regarding claims 1 and 5, Touchy discloses a p-type gallium nitride-based device comprising: a device structure that includes at least one p-type Group III nitride layer (GaN) (col. 2, lines 10-15 and 30-35) that includes some gallium; a first silicon dioxide layer on said p-layer (col. 2, lines 50-52); and a layer of a Group II metal source composition (containing Mg or Zn) on said first SiO_2 layer (col. 3, lines 1-4 and 31-33). Note that Touchy disclose the dopant material (diffusion source) may be deposited by a spin-on process (col. 3, lines 31-33), meaning the diffusion source (Mg or Zn composition) is in the form of a solid layer. The difference between Touchy and the claimed invention is a second silicon dioxide layer on said Group II metal source composition layer. Figure 5 of Ogihara discloses a SiO_2 cap layer 22 (col. 4, lines

3-5) over a diffusion source layer 20. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Touchy by including a second SiO_2 layer over the diffusion source layer for the purpose of preventing escape of the diffusion impurity into the ambient space (col. 3, lines 37-41 of Ogihara).

Regarding claim 3, Touchy discloses the Group III elements (in this case Ga) and the group II metal elements diffuse through the protective layer (first SiO_2 layer) (col. 5, lines 16-29). Therefore, the first SiO_2 layer must be thick enough to create vacancies to a depth in said p-type layer that encourage atoms of said Group II metal to diffuse thereinto while still permitting diffusion from said Group II metal source composition.

Regarding claim 4, Touchy discloses the first SiO_2 layer is in the range of 500-1500 angstroms. Touchy does not specifically disclose the first SiO_2 layer is about 1000 angstroms thick, the Group II metal source composition layer is about 1000 angstroms thick, and the second SiO_2 layer is about 2500 angstroms thick. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify Touchy by selecting the claimed thickness values, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 8, it is inherent that the metal source composition layer of Touchy comprises some type of metal-containing compound.

Regarding claim 10, Touchy discloses the Group II metal source composition layer is GaN, which reads on the claim when x=1 and y=0 (col. 2, lines 30-35).

Claims 2 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara as applied to claim 1 above, and further in view of Edmond et al. (US Pat. 5,523,589, hereinafter Edmond).

Regarding claim 2, Touchy discloses the p-type semiconductor layer is used in an electro-luminescent semiconductor device (col. 1, lines 47-50). A further difference between Edmond and the claimed invention is the device comprises a conductive silicon carbide substrate; a conductive buffer layer on said silicon carbide substrate; and an n-type Group III nitride layer on said buffer layer. Figure 1 of Edmond discloses a light-emitting device comprising a SiC substrate 21, a conductive buffer layer 23 on said substrate; and an n-type Group III nitride layer 27 on said buffer. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Touchy by using the structure of Edmond for the purpose of fabricating a LED that can emit blue light and can be built in the vertical geometry (col. 3, lines 52-57 of Edmond).

Regarding claim 8, it is inherent that the metal source composition layer of Touchy comprises some type of metal-containing compound.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara, as applied to claim 1 above, and further in view of Iguchi et al. (US Pat. 6,214,708, hereinafter Iguchi).

Regarding claim 9, a further difference between Touchy and the claimed invention is the compound is selected from the group consisting of magnesium nitride and zinc phosphide. Iguchi discloses doping a III-V semiconductor with Zn by using zinc phosphide (col. 9, lines 48-52). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by using zinc phosphide as the diffusion source material for the purpose of selecting a well known diffusion source zinc compound.

Claims 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara, as applied to claim 1 above, and further in view of Nobori et al. (US Pat. 6,291,328, hereinafter Nobori).

Regarding claim 11 and 13, a further difference between Touchy and the claimed invention is a plurality of silicon dioxide portions on said p-type Group III nitride layer, with a respective portion of said source composition on each said silicon dioxide portion. Figures 1 and 2 of Nobori discloses an array of LED's (shown as hatched portions in Figure 1), wherein each LED has a diffusion area 15 and a diffusion source layer 12 over the diffused area. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by having a plurality of separate diffusion areas, wherein each area is covered by a separate diffusion source layer. The ordinary artisan would have been motivated to modify Touchy in the manner described above for the purpose of fabricating a plurality of LED's on the same substrate. Regarding 13, it would also be obvious to

have the second silicon dioxide layer (diffusion cap layer) covering said source composition portions and portions of the p-type Group III nitride layer as taught by Nobori (element 14 in Figure 2), for the purpose of simplifying the production process.

Claims 1, 2, 7, and 14-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Omi et al. (US Pat. 6,549,552, hereinafter Omi) in view of Touchy and Ogihara.

Regarding claims 1, 2, and 14, Figure 1 of Omi discloses a light emitting device comprising: a conductive silicon carbide substrate 1; a conductive buffer layer 2 on said silicon carbide substrate for provided a crystal transition between said substrate and said GaN portions of said device; an n-type GaN layer 3 on said buffer layer; and an Mg-doped p-type GaN layer 9 (col. 9, lines 14-16) on said n-type layer. A difference between Omi and the claimed invention is a first silicon dioxide layer on said p-type layer; a magnesium layer on said first SiO_2 layer for supplying p-type dopant to said p-type layer. Touchy discloses a method of p-doping a GaN layer wherein an intermediate product comprises at least one p-type Group III nitride layer (GaN) (col. 2, lines 10-15 and 30-35) that includes some gallium; a first silicon dioxide layer on said p-layer (col. 2, lines 50-52); and a layer of a Group II metal source composition (containing Zn or Mg) on said first SiO_2 layer (col. 3, lines 1-4 and 31-33). Note that Touchy disclose the dopant material (diffusion source) may be deposited by a spin-on process (col. 3, lines 31-33), meaning the diffusion source (Zn or Mg composition) is in the form of a layer. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made

to modify the invention of Omi by doping the p-GaN layer using the method of Touchy, and therefore the intermediate structure of Touchy (comprising an SiO_2 layer over the p-GaN layer, and a diffusion source layer over the SiO_2 layer). Touchy also discloses the Group III elements (in this case Ga) and the group II metal elements diffuse through the protective layer (first SiO_2 layer) (col. 5, lines 16-29). Therefore, the first SiO_2 layer must be thick enough to create vacancies to a depth in said p-type layer that encourage atoms of said Group II metal to diffuse thereinto while still permitting diffusion from said Group II metal source composition. The limitation "when said device is heated to temperatures between about 750 and 950 degrees" is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art. The ordinary artisan would have been motivated to modify Omi in the manner described above for the purpose of selecting inexpensive and well-known process for implanting Mg into the p-layer of Omi. A further difference between Omi and the claimed invention is a second silicon dioxide layer on said Group II metal source composition layer. Figure 5 of Ogihara discloses a SiO_2 cap layer 22 (col. 4, lines 3-5) over a diffusion source layer 20. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by including a second SiO_2 layer over the diffusion source layer for the purpose of preventing escape of the diffusion impurity into the ambient space (col. 3, lines 37-41 of Ogihara).

Regarding claims 7 and 15, Figure 1 of Omi discloses the substrate 1 is n-type (col. 4, lines 25-27). Further regarding claim 8, Omi does not specifically disclose the substrate has a carrier concentration of between about 1×10^{16} cm^{-3} and about 1×10^{19} cm^{-3}. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to

further modify the invention of Omi by using a carrier concentration within the claimed range, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claim 16, Figure 1 of Omi discloses the buffer layer 2 is a homogeneous layer of GaN (col. 4, lines 26-28).

Regarding claim 17, Figure 1 of Omi discloses the n-type layer 3 comprises AlGaN (col. 4, lines 28-30) (when y=0).

Regarding claim 18, Figure 1 of Omi discloses the p-type layer 9 comprises GaN (col. 4, lines 33-35) (when x=1 and y=0).

Allowable Subject Matter

Claim 12 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

Applicant's arguments filed June 15, 2006 have been fully considered but they are not persuasive.

Applicant argues that "The Touchy and Ogihara devices differ significantly from one another with regard to device structure, composition of various layers present therein, and their requisite function of the various device layers" and that therefore "there is no motivation or suggestion to combine the teachings of these patents". It appears Applicant is arguing that the art is not analogous, since the above rejection clearly provided a motivation to combine the teachings. However, both references are from the same field of endeavor since they both deal with diffusing p-type dopants into a substrate using solid-state diffusion. Therefore, the art is sufficiently analogous to make the combination proposed in the above rejection. Applicant further argues, "Even if one of ordinary skill in the art were to combine the teachings of the cited patents (which Applicant submits there is no suggestion or motivation to do), the resultant device would not be the same as claimed. Ogihara requires the capping layer to be formed of a material, such as aluminum hydride, that has the property of blocking the passage of an impurity (zinc)". The Examiner respectfully disagrees with this statement. At no point in the above rejection did the Examiner suggest incorporating the aluminum hydride layer of Ogihara into the device of Touchy. As stated in the above rejection, Ogihara discloses the anneal cap layer can be SiO_2 (col. 4, lines 3-5). It was the SiO_2 cap layer that was incorporated into the device of Touchy. The potential to block impurities depends other factors besides just the type of material. For instance, the thickness of the layer plays a significant role in determining whether or not a layer will block impurities. Touchy clearly discloses the dopant impurities diffuse through the SiO_2 film, and Ogihara clearly discloses the SiO_2 film 22 blocks diffusion. Therefore, the motivational statement cited by the Examiner is valid and the 103 rejection is proper.

Regarding claim 2, Applicant argues, "The Touchy device is produced by doping a surface of a Group III-V semiconductor monocyrstal. Column 1, lines 48-49. Edmond addresses the problem of crystal lattice matching in the production of GaN LEDs. Because Touchy doped the surface of a Group III-V crystal to form its device, crystal lattice mismatch is not a problem. Accordingly, there is no motivation to make the modification suggested by the Examiner". The Examiner acknowledges that Touchy does disclose directly doping a surface of a GaAs wafer, and that when using a GaAs wafer there is no need to include the SiC substrate and buffer layer. However, the embodiment of Touchy relied upon in the above rejection was for a GaN nitride semiconductor layer (col. 2, lines 30-35). As is known in the art, GaN wafers are not readily available for device fabrication. Therefore, GaN layers must be grown on another substrate, such as SiC. When growing GaN on a SiC substrate, a buffer layer is required to accommodate lattice mismatch. Therefore, when using the embodiment of Touchy which dopes a GaN layer, it would have been obvious to incorporated the SiC substrate and buffer layer as taught by Edmond. Therefore, the above rejection is proper.

Regarding claims 11 and 13, Applicant argues that the Touchy process results in the production of continuous layers on the substrate and that "Touchy does not suggest any modification to its process to provide a device having a plurality of silicon dioxide portions...". However, there is no requirement that a primary reference must teach a motivation for the combination. The Examiner acknowledges that Touchy does not disclose a plurality of silicon dioxide portions. That is why Touchy was combined with another reference that does teach that claimed feature, and a reason for having that feature. Applicant further argues "Nobori does not teach or suggest silicon dioxide as a suitable material for the capping layer". However, Nobori is

not relied upon for the material of the cap layer, but instead for the teaching of the particular layout/location of the layer. Ogihara was relied upon for teaching the SiO_2 capping layer. Both the capping layer of Ogihara and the capping layer of Nobori serve the purpose of preventing the escape of impurity atoms. Applicant also argues that since the Nobori device has some different structural elements from that of the Touchy and Ogihara, there is no suggestion or motivation to combine the teachings thereof. Once again, it is assumed that Applicant is arguing the art is not analogous, since the above rejection provided a motivation for making the combination. All cited references are from the same field of endeavor (doping a semiconductor layer with solid-state diffusion), and both Ogihara and Nobori include a cap layer to prevent escape of impurity atoms. Therefore, the art is sufficiently analogous to make the combination proposed in the above rejection. There is no requirement that references must have nearly identical structures in order to make a 103 rejection. Therefore, the combination is proper.

Applicant argues, "Omi does not teach or suggest a diffusion doping process. Rather, in Omi, various layers are already doped prior to application to the substrate...". The Examiner acknowledges that Omi does not teach a diffusion doping process, which is why it was combined with Touchy. The point of the above 103 rejection was to use the dopant diffusion process of Touchy to dope layer 9 of Ohmi. In other words, instead of deposited layer 9 as an in-situ doped layer, the proposed combination would first deposit layer 9 undoped, then use the solid-state diffusion process of Touchy to implant p-type dopants. The proposed combination would make an intermediate product. Applicant further points out structural differences between the two patents and concludes there would be no motivation to combine. However, the art is sufficiently

analogous to make the combination, and the motivation for doing so was provided in the above rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew C. Landau whose telephone number is (571) 272-1731.

The examiner can normally be reached from 8:30 AM - 5:30 PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone numbers for the organization where this application

or proceeding is assigned are (571) 273-8300 for regular communications and (571) 273-8300 for After Final communications.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should any questions arise regarding access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew C. Landau

August 19, 2006

KENNETH PARKER
SUPERVISORY PATENT EXAMINER